7.0 AIRPLANE SPECIFIC EVIDENCE OF MSD/MED

7.1 HEALTH OF FLEET WITH REGARD TO WIDESPREAD FATIGUE DAMAGE SOURCES

It can be easily demonstrated that a significant effort is being made in the industry to assess, inspect, and modify airplane structure to maintain the highest level of safety. Most of the individual activities, which are part of the larger effort, can trace at least part of their origins to an early report and resolution of a discrete problem by an operator/manufacturer team. While not geared specifically to identification of potential WFD issues, the current system of operator/manufacturer communications has in retrospect been quite useful in identification and resolution of a number of issues which can today be classified as WFD concerns. A discussion of some examples will be covered in section 7.3.

7.1.1 Background -- The Communication Process Today.

The basic processes currently used to facilitate these operator/manufacturer communications have changed little over the years, although technology has improved the speed of communication. Also, an increasing awareness of the potential long-term effects of structural repairs has caused a corresponding increase in the number of issues presented to the manufacturer.

In order for the manufacturer to conduct the necessary analyses on individual airplanes and begin or continue an assessment of fleet impact, several key data elements are documented:

- Operator
- Aircraft Line No.
- Hours/Cycles
- When/How discovered
- Damage Description; location, geometry, size, related factors such as adjacent damage, prior occurrences, mitigating factors
- Sketches/photos may be submitted
- A proposed repair may also be suggested

The manufacturer catalogs the information and generates the necessary data to substantiate a disposition of the condition:

- Repair design
- Special conditions/processes such as cold working, specific shoring requirements, etc.

- Follow-up inspections, if required
- OEM analysis and assessment of failed component(s).

The manufacturer may initiate additional communications with other operators to solicit feedback on possible related occurrences. These related occurrences may not have been previously reported for a variety of reasons, such as operator decision to replace versus repair, or damage was detected and corrected at an earlier stage with existing data.

The manufacturer combines this feedback with earlier reports, and assesses the issue for possible further action. Dialog with operators is maintained through a variety of methods including manufacturer representatives, Telex, operator letters, and contact through groups like the STGs. All are valid means for information collection and dissemination.

The existing communication process has been demonstrably effective in identifying MSD/MED, but there is room to improve

7.1.2 Additional Operator Actions

The operator should make every effort to provide the following information to the OEM or STC holder to help identify and resolve potential MSD/MED issues sooner:

All Cases

- An exact description of the damage, including crack length, location, flight cycles/hours, and condition of structure.
- Diagram of crack orientation.
- Crack specimen from service airplane (damaged structure may be needed for detailed examination), when requested
- Results of follow-up inspections by operator that identify similar problems on other airplanes in the fleet

MSD

- Re-occurring findings of similar problem in fleet
- Findings where inspections accomplished during the initial repair identify additional damage sites
- Adjacent repairs with similar types of damage

MED

- Operator inspection finds damage at multiple locations

7.1.3 Additional OEM Actions

The OEMs will also need to add or improve capabilities in the identification process. Some example areas:

- Review service history files for possible fleet data to find or verify trends
- If only limited fleet data is available, it may be necessary to support with additional near-term analysis to predict or confirm occurrence as an MSD/MED issue (as opposed to incidental or random damage)
- Verify that similar adjacent details are in fact similar in detail and operating at similar stress levels before classifying a single event or single location as MSD or MED.
- Educate OEM Support personnel to potential MSD/MED scenarios.

7.1.4 OEM/Operator Improved Communication Improvements

Operators and OEMs need to institutionalize a more robust communications model to provide the greater detail described above, and ensure potential issues are recognized sooner. In addition to the external communications between the parties, internal processes and communications models will need to be improved. In particular;

- Operators must work to report all findings, not just report the first few findings and then stop reporting additional findings because they are an old subject
- Diligence will be required on the part of the operators to assure that a developing MED problem is not masked by parts replacement at repetitive maintenance visits
- OEMs also need to look at other ways to uncover potential MSD/MED issues, such as spares demand for susceptible details
- Steps need to be taken to raise awareness at operators in maintenance organizations in addition to the few engineering groups involved

7.1.5 Role of the STG

The STGs have proven to be a key resource in the overall effort to improve the structural health and safety of the transport fleet. The STGs can play an ongoing, constructive part in the management of MSD/MED issues. Operator STG members should participate in OEM planning, and assist in the OEM evaluation and management of potential MSD/MED susceptible structure. Some specific suggestions include:

- For all models exceeding 75% DSG the OEM will develop and maintain a current listing of MSD/MED susceptible locations. This listing will be reviewed by the STG and made available to all operators of that model by the OEM customer support organization.
- When appropriate, the STG will recommend that a formal MSD/MED susceptible area inspection program be initiated focusing on the active high time airplanes (over 75% DSG) from each of the models included in tasking. Operators of these airplanes would be requested to provide Fractography specimens from each of the susceptible areas at the next D-Check. OEMs would provide preplanned repairs and/or replacement parts as applicable. Samples would provide flaw or crack distribution data.

- Add notes in SRM and operator-developed standard repairs for maintenance staff to notify Engineering with details of repairs.

7.2 VALUE OF SERVICE DIFFICULTY REPORTS

7.2.1 Evaluation Process

The existing FAA Service Difficulty Reporting database, collected per FAR 121.703, was researched and evaluated by AAWG OEMs and an operator (Delta). The process consisted of down-loading the database from the FAA s website, application of key word query programs keyed to a date range from January 1, 1996 to May 1, 1998, all fuselage entries, and all operator reports for B727, 737, 747, L1011 and DC-9 airplane models. The key word search consisted of identification of all cracked structure in fuselage skins, pressure bulkheads and stringers and/or longerons, as applicable.

7.2.2 Results and Conclusions

Ten percent of fuselage skin crack reports on one model airplane indicated MSD in individual skin panels. None of the individual reports indicated MED cracks in fuselage frames or pressure bulkheads.

The conclusions of the AAWG concerning the effectiveness of SDR data for evaluating the health of the fleet with respect to widespread fatigue damage can be summarized as follows:

- The quality of discrepancies reported on the SDRs required considerable model-specific expertise to understand and analyze the reports

- The report format is not conducive to automated analysis

- SDRs are not timely, often lagging other more direct methods (full scale fatigue tests, operator/OEM repair coordination, AAWG Structures Task Group

meetings, etc.) routinely used to identify susceptible areas by significant periods of time.

- The data was not representative of the world-wide fleet
- Cracks reported individually did not make any multiple events apparent without prior knowledge of the reviewer
- There were no new MSD/MED findings, i.e. not already identified by the OEM without service actions already in place
- Some usefulness in providing an indication of frequency of occurrence

Based on this activity, AAWG has concluded that further or ongoing review of SDR data is not a necessary or beneficial process in the identification or resolution of WFD related service problems. Furthermore, much difficulty was experienced in establishing trends from the data.

7.3 AIRPLANE SPECIFIC EVIDENCE OF MSD/MED

7.3.1 Evaluation Process

AAWG members conducted a review of fatigue test and service data to determine the health of the fleet with respect to widespread fatigue damage.

The data collected and summarized consisted of identification of design detail, source of the data, type of problem (MSD/MED) encountered, number of airplanes affected, service action status, service action threshold, and regulatory status.

7.3.2 Results and Conclusions

Limited MSD/MED test or service findings were identified on each model surveyed. (B727, 737, 747, L1011, A300, A310, DC-9, BAe1-11) Susceptible structure consisted of fuselage longitudinal and crown circumferential skin joints, fuselage stringer splices, pressure bulkheads, (rings / web splice and attach angle) shear ties, skin at stringer run-outs, skins and beams, frames in flat fuselage areas, doorskin flat pressure bulkheads, fuselage frames adjacent to doorways, horizontal stabilizer stringer subject to acoustic excitation, window band areas, frames below cargo door cutouts, and wing chordwise splices, cargo door latch spool attachments, wing box drain holes wheel well pressure panel beams.

All A-300 and A-310 MSD/MED problems were identified by test. The remaining fleets were primarily, but not exclusively, identified by service reports.

Service actions have been issued for every finding each service action resulted in the issuance of airworthiness directives to mandate inspections in each case.

7.3.3 Airplane Specific Instances Of MED / MSD

Table 7.3.3.1 Specific Evidence of MSD/MED In-Service or Test

SECTION 5.2 FIGURE No.	DESIGN DETAIL DESCRIPTION	SOURCE OF DATA SERVICE / TEST	MSD OR MED
1	FUSELAGE LONGITUDINAL LAP JOINT	T	MSD
1	FUSELAGE LONGITUDINAL BUTT JOINT	T	MSD
1	FUSELAGE LONGITUDINAL LAP JOINTS	S	MSD
1	FUSELAGE UPPER ROW LAPSPLICE	S	MSD
1	FUSELAGE UPPER ROW LAPSPLICE	S/T	MSD
1	FUSELAGE LOWER ROW LAP SPLICE	S/T	MSD
1	FUSELAGE LOWER ROW LAP SPLICE	S	MSD
1	FUSELAGE LONGITUDINAL SKIN LAPS AND TEAR STRAPS	S/T	MSD
1	FUSELAGE WINDOW BELT LAP SPLICE	S	MSD
2	FUSELAGE STRINGER COUPLING	T	MED
2	FUSELAGE CIRCUMFERENTIAL JOINT	T	MSD
2	FUSELAGE CIRCUMFERENTIAL JOINT	S	MSD
2	FUSELAGE CIRCUMFERENTIAL JOINT	S	MSD
2	FUSELAGE CIRCUMFERENTIAL JOINT	S	MSD
2	AFT PRESSURE BULKHEAD CROWN STRINGER FITTING	S	MED
3	FUSELAGE MILLED RADIUS	T	MSD
4	FRAME FEET (CENTER FUSELAGE)	S	MED
4	FUSE FRAMES CRACKING ADJACENT TO FWD PASSENGER DOORWAY	S	MED
4	FUSELAGE SECT 46 FRAMES	S	MED
4	SECT 43 FRAMES BELOW MAIN DECK CARGO DOOR	S	MED
4	FRAMES BELOW MAIN DECK CARGO DOOR	S	MED
4	FUSELAGE LOWER LOBE FRAMES	S	MED
4	FUSELAGE FRAMES AND FLOOR BEAMS IN FLAT SIDED AREAS	T	MED
4	FUSELAGE AFT UPPER FRAMES	T	MED
4	FUSELAGE AFT LOWER FRAMES	T	MED
4	FRAMES ABOVE PASSENGER WINDOW	S	MED
5	FUSELAGE STRINGER TO FRAME ATTACH	S	MED
6	FUSELAGE SHEAR CLIP END FASTENERS ON SHEAR TIED FRAMES	S	MED

Table 7.3.3.1 Specific Evidence of MSD/MED In-Service or Test Continued

SECTION 5.2 FIGURE No.	DESIGN DETAIL DESCRIPTION	SOURCE OF DATA SERVICE / TEST	MSD OR MED
7	REAR PRESSURE BULKHEAD	T	MSD
7	REAR PRESSURE BULKHEAD ATTACH ANGLES	T	MSD
7	REAR PRESSURE BULKHEAD ATTACH ANGLES	T	MSD
7	AFT PRESSURE DOME OUTER RING AND DOME WEB SPLICES	S	MSD
7	AFT PRESSURE BULKHEAD WEB SPLICE	S	MSD
7	AFT PRESSURE BULKHEAD TEE	S	MSD
7	AFT PRESSURE BULKHEAD CROWN STRINGER FITTING	S	MED
8	CIRCUMFERENTIAL SKIN JOINT AT AFT PRESSURE BULKHEAD	S	MSD
9	FUSELAGE CENTER SECTION SHEAR PLATES	T	MED
9	FUSELAGE CENTER SECTION SHEAR WEB	S	MSD
9	FUSELAGE GANTRIES	S/T	MSD
10	FUSELAGE WINDOW BELT	S	MSD
11	OVERWING FUSELAGE ATTACH	S	MED
11	FUSELAGE OVERWING FRAMES AT FLOOR	S	MED
12	UPPER CARGO DOOR LATCH SPOOL BOLTS	S	MED
13	FUSELAGE DOUBLER RUNOUT BELOW AIRSTAIR DOOR CUTOUT	S	MSD
14	WING TOP SKIN AND STRINGER JOINT AT RIB	S/T	MSD
14	WING-CHORDWISE SPLICES (S.O.B. SPLICE PLATE)	S	MSD
14	WING LOWER PANEL JUNCTION FITTING	T	MSD
15	WING LEADING EDGE RIB	S	MSD
16	WING BOTTOM SKIN STRINGER RUN-OUTS ADJACENT TO RIB	S/T	MED
16	CRACKS IN SPANWISE STRINGERS OF HORIZONTAL STABILIZER	S	MED
16	CENTER WING BOX CROSSING AREAS	T	MED
16	CENTER WING BOX DRAIN HOLES	T	MED